

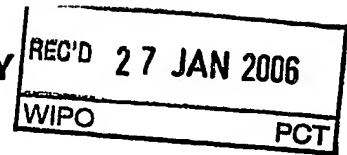
PATENT COOPERATION TREATY


PCT

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

(Chapter II of the Patent Cooperation Treaty)

(PCT Article 36 and Rule 70)



Applicant's or agent's file reference 21E015812WO3	FOR FURTHER ACTION		See Form PCT/PEA/416
International application No. PCT/IB2004/000382	International filing date (day/month/year) 16.02.2004	Priority date (day/month/year) 09.10.2003	
International Patent Classification (IPC) or national classification and IPC B09B3/00, B29B17/02			
Applicant DI GIOVANNI, Maurizio			
<p>1. This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.</p> <p>2. This REPORT consists of a total of 5 sheets, including this cover sheet.</p> <p>3. This report is also accompanied by ANNEXES, comprising:</p> <p>a. <input checked="" type="checkbox"/> sent to the applicant and to the International Bureau a total of 10 sheets, as follows:</p> <p><input type="checkbox"/> sheets of the description, claims and/or drawings which have been amended and are the basis of this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions).</p> <p><input type="checkbox"/> sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box.</p> <p>b. <input type="checkbox"/> (sent to the International Bureau only) a total of (indicate type and number of electronic carrier(s)) , containing a sequence listing and/or tables related thereto, in computer readable form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).</p>			
<p>4. This report contains indications relating to the following items:</p> <p><input checked="" type="checkbox"/> Box No. I Basis of the opinion</p> <p><input type="checkbox"/> Box No. II Priority</p> <p><input type="checkbox"/> Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability</p> <p><input type="checkbox"/> Box No. IV Lack of unity of invention</p> <p><input checked="" type="checkbox"/> Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement</p> <p><input type="checkbox"/> Box No. VI Certain documents cited</p> <p><input checked="" type="checkbox"/> Box No. VII Certain defects in the international application</p> <p><input type="checkbox"/> Box No. VIII Certain observations on the international application</p>			
Date of submission of the demand 04.08.2005		Date of completion of this report 26.01.2006	
Name and mailing address of the international preliminary examining authority:  European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tlx 523656 epmu d Fax: +49 89 2399 - 4465		Authorized Officer Clarke, A Telephone No. +49 89 2399-8421	



**INTERNATIONAL PRELIMINARY REPORT
ON PATENTABILITY**

International application No.
PCT/IB2004/000382

Box No. I Basis of the report

1. With regard to the **language**, this report is based on the international application in the language in which it was filed, unless otherwise indicated under this item.
- ☐ This report is based on translations from the original language into the following language , which is the language of a translation furnished for the purposes of:
- ☐ international search (under Rules 12.3 and 23.1(b))
 - ☐ publication of the international application (under Rule 12.4)
 - ☐ international preliminary examination (under Rules 55.2 and/or 55.3)
2. With regard to the **elements*** of the international application, this report is based on *(replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report):*

Description, Pages

1-46 as originally filed

Claims, Numbers

1-34 received on 04.08.2005 with letter of 03.08.2005

Drawings, Sheets

1/3-3/3 as originally filed

- ☐ a sequence listing and/or any related table(s) - see Supplemental Box Relating to Sequence Listing
3. ☐ The amendments have resulted in the cancellation of:
- ☐ the description, pages
 - ☐ the claims, Nos.
 - ☐ the drawings, sheets/figs
 - ☐ the sequence listing (*specify*):
 - ☐ any table(s) related to sequence listing (*specify*):
4. ☐ This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).
- ☐ the description, pages
 - ☐ the claims, Nos.
 - ☐ the drawings, sheets/figs
 - ☐ the sequence listing (*specify*):
 - ☐ any table(s) related to sequence listing (*specify*):

* If item 4 applies, some or all of these sheets may be marked "superseded."

**INTERNATIONAL PRELIMINARY REPORT
ON PATENTABILITY**

International application No.
PCT/IB2004/000382

Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes: Claims	1-34
	No: Claims	
Inventive step (IS)	Yes: Claims	1-34
	No: Claims	
Industrial applicability (IA)	Yes: Claims	1-34
	No: Claims	

2. Citations and explanations (Rule 70.7):

see separate sheet

Box No. VII Certain defects in the international application

The following defects in the form or contents of the international application have been noted:

see separate sheet

Re Item V

**Reasoned statement with regard to novelty, inventive step or industrial applicability;
citations and explanations supporting such statement**

Reference is made to the following documents:

- D1: WO 01/94457 A (DU PONT CANADA) 13 December 2001
D2: US 5 876 644 A (MOORE TONY CLIFFORD ET AL) 2 March 1999
D3: US 5 789 636 A (NIEMANN KLAUS ET AL) 4 August 1998

The document D1 is regarded as being the closest prior art to the subject-matter of claim 1, and shows a process for recycling waste from which the subject-matter of claim 1 differs at least in that an oxidising step takes place and that the waste is treated in the presence of catalysts comprising a mixture of molecular sieves, kaolin, clay and sodium aluminium silicates.

The subject-matter of claim 1 is therefore new (Article 33(2) PCT).

The problem to be solved by the present invention may be regarded as the improvement of demolition-depolymerisation of the waste material.

The solution to this problem proposed in claim 1 of the present application is considered as involving an inventive step (Article 33(3) PCT) since no available prior art document suggests an oxidising step in such a reprocessing system, furthermore there is no catalyst comprising a mixture of molecular sieves, kaolin, clay and sodium aluminium silicates.

The same arguments apply mutatis mutandis to the independent system and use claims 17, 32, 33, and 34.

Claims 1 to 16, 18 to 31 are dependent on claim 1 and 17 respectively and as such also meet the requirements of the PCT with respect to novelty and inventive step.

Re Item VII

**INTERNATIONAL PRELIMINARY
REPORT ON PATENTABILITY
(SEPARATE SHEET)**

International application No.

PCT/IB2004/000382

Contrary to the requirements of Rule 5.1(a)(ii) PCT, the relevant background art disclosed in the documents D1 is not mentioned in the description, nor are these documents identified therein.

The description is not in conformity with the claims as required by Rule 5.1(a)(iii) PCT.

-1-

AMENDED CLAIMS (Clean copy)

1. An industrial process for recycling every type of waste, comprising the following steps:
 - 5 a) physical preliminary treatment for waste volumetric reduction and compacting, so as to obtain a homogeneous refined mixture free of ferrous/metal and/or too large residues;
 - b) feeding said mixture deriving from step a) into a
10 first chamber of a multistage reactor, in which the mixture undergoes an oxidative demolition-depolymerization process;
 - c) feeding said oxidized mixture deriving from step b) into a solid-liquid extractor, in which the mixture
15 is separated into its components, so as to obtain a biologically stable, sterile, fluid organic phase and a solid sterile dry phase; or
 - d) feeding said oxidized mixture deriving from step b) into a second chamber of said multistage reactor,
20 in which the mixture is activated to a repolymerization process;
 - e) feeding said activated mixture deriving from step d) into a third chamber of said multistage reactor, in which said repolymerization develops, and then
25 into suitable collection or conveying means, in

-2-

which said repolymerization reaction is completed,
so as to obtain a sterile stable expanded polymer;
said process being characterized in that:

5 - the oxidative demolition-depolymerization reaction
of step b) is carried out by intensively mixing the
mixture from step a) with a super-oxidizing mixture
in the presence of catalysts comprising a mixture
of molecular sieves, kaolin, clay, sodium aluminum
silicates;

10 - the repolymerization reaction of step d) is car-
ried out by intensively mixing said oxidized mixture
with a repolymerizing mixture, in the presence of
catalysts.

2. The process according to claim 1, comprising the
15 following steps:

a) physical preliminary treatment for waste volumetric
reduction and compacting, so as to obtain a homoge-
nous refined mixture free of ferrous/metal and/or
too large residues;

20 b) feeding said mixture deriving from step a) into a
first chamber of a multistage reactor, in which the
mixture undergoes an oxidative demolition-
depolymerization process;

c) feeding said oxidized mixture deriving from step

25 b) into a solid-liquid extractor, in which the mixture

-3-

is separated into its components, so as to obtain a biologically stable, sterile, fluid organic phase and a solid sterile dry phase;

said process being characterized in that:

- 5 - the oxidative demolition-depolymerization reaction of step b) is carried out by intensively mixing the mixture from step a) with a super-oxidizing mixture in the presence of catalysts comprising a mixture of molecular sieves, kaolin, clay, sodium aluminum
10 silicates.

3. The process according to claim 1, comprising the following steps:

- a) physical preliminary treatment for waste volumetric reduction and compacting, so as to obtain a homoge-
15 nous refined mixture free of ferrous/metal and/or too large residues;
- b) feeding said mixture deriving from step a) into a first chamber of a multistage reactor, in which the mixture undergoes an oxidative demolition-
20 depolymerization process;
- d) feeding said oxidized mixture deriving from step b) into a second chamber of said multistage reactor, in which the mixture is activated to a repolymeri-
zation process;
- 25 e) feeding said activated mixture deriving from step

-4-

d) into a third chamber of said multistage reactor, in which said repolymerization develops, and then into suitable collection or conveying means, in which said repolymerization reaction is completed, so as to obtain a sterile stable expanded polymer; said process being characterized in that:

- the oxidative demolition-depolymerization reaction of step b) is carried out by intensively mixing the mixture from step a) with a super-oxidizing mixture in the presence of catalysts comprising a mixture of molecular sieves, kaolin, clay, sodium aluminum silicates;

- the repolymerization reaction of step d) is carried out by intensively mixing said oxidized mixture with a repolymerizing mixture, in the presence of catalysts.

4. The process according to anyone of claims 1 to 3, in which the single steps thereof are performed in continuous cycle.

5. The process according to anyone of claims 1 to 4, in which said molecular sieves are metered from about 1% to about 4% by weight, with respect to the weight of waste entering the reactor.

6. The process according to anyone of claims 1 to 4, in which before being added to the mixture of cata-

-5-

lysts, kaolin is activated by heating at 1200°C.

7. The process according to anyone of claims 1 to 4, in which said mixture of catalysts has the following composition in percentage by weight: 75% of molecular
5 sieves, 10% of kaolin, 8% of clay, 7% of sodium aluminum silicate blue powder.

8. The process according to anyone of claims 1 to 7, characterized in that said super-oxidizing mixture is prepared by mixing two different oxidizing solutions
10 prepared each in two turbo-electrophotolytic reactors, and comprises an amount of highly reactive oxidizing species, such as hydroxyl radicals $\cdot\text{OH}$, ozone O_3 , sodium hypochlorite NaClO , peroxides.

9. The process according to claim 8, in which the
15 first one of said two oxidizing solutions is prepared by treatment in a turbo-electrophotolytic reactor of an acid mixture A) comprising: peroxides, acetic acid, citric acid, stabilizers.

10. The process according to claim 9, in which said
20 mixture A) has the following composition in percentage by weight: peroxides, 50-80%; acetic acid, 7-15%; citric acid, 5-13%; stabilizers, 1%.

11. The process according to claim 10, in which the
25 second one of said two oxidizing mixtures is prepared by treatment in a turbo-electrophotolytic reactor of a

-6-

mixture B) comprising an aqueous phase added with brine.

12. The process according to claim 11, in which said aqueous phase is recycled through waste oxido-
5 destruction process.

13. The process according to claims 11 and 12, in which brine contains NaCl in an amount of 5-10% by weight and is present in an amount of about 10-20% by weight with respect to the recycled aqueous phase.

10 14. The process according to anyone of claims 1 to 7, in which said repolymerization mixture comprises:

- a mixture of diphenyl-methane-4,4'-diisocyanate and/or isomers and homologues thereof, containing about 25% to 35% of NCO groups, preferably about 30
15 to 32%; said mixture being dispersed into an isomeric mixture of xilenes;
- diazabicyclooctane (DABCO);
- additives, such as N,N-dimethyl-acetylamine or N,N-dimethyl-aminoethanol;
- 20 - catalysts.

15. The process according to claim 14, in which said catalysts comprise a mixture of molecular sieves, kaolin, clay, sodium aluminum silicates.

16. The process according to claim 15, in which in
25 said mixture of catalysts sodium aluminum silicate in

-7-

blue powder is added in a concentration of 6.5 to 16.5% by weight.

17. A system for carrying out the process according
5 to any of the preceding claims, comprising at least:

- a first section, comprising one or more modules,
connected one to the other, for crushing, compact-
ing and homogenizing waste;

10 - a second section, comprising a single stage or mul-
tistage reactor, for submitting said refined waste
coming from the first section to an oxidative demo-
lition-depolymerization process followed or not by
a subsequent repolymerization process.

18. The system according to claim 17, in which said
15 first section comprises means for breaking, eliminat-
ing metal residues, crushing, refining and compacting
waste.

19. The system according to claim 18, in which said
means are connected in series one to the other through
20 belt conveyors and/or separators and related loading
devices.

20. The system according to claim 17, in which said
second section comprises a multistage reactor includ-
ing in its turn:

25 - a device for loading refined waste;

-8-

- a first chamber, in which the oxidative demolition-depolymerization process occurs;
- a second chamber, in which the repolymerization process is activated;
- 5 - a third chamber; in which the repolymerization process develops, during the transfer of the waste mixture towards the reactor discharge.

21. The system according to claim 20, in which:

- said first chamber has a section shaped like a cyl-
10 inder and a frustum of cone;
- said second chamber has a section shaped like a cylinder and a frustum of cone;
- said third chamber has a cylindrical section.

22. The system according to claims 20 and 21, in
15 which said chambers are connected in series one to the other and are provided with means for mixing and conveying the waste mass to be transformed.

23. The system according to any of the claims 20 to 22, in which said mixing and conveying means comprise
20 a shaft-free double blade rotary spiral, having the same profile as the reactor chambers.

24. The system multistage reactor according to any of the claims 20 to 23, in which said chambers also comprise means for metering, restoring, recovering and
25 recycling reagents and catalysts.

-9-

25. The system multistage reactor according to any of the claims 20 to 24, in which the oxido-destruction process is carried out continuously.

26. The system according to claim 17, in which said
5 second section further comprises:

- tanks for storing reagents;
- two turbo-electrophotolytic reactors for producing on-site the super-oxidizing mixture;
- devices for controlling and managing the system.

10 27. The system according to any of the claims 17 to 26, in which the waste processing process is carried out continuously.

28. The system according to any of the claims 17 to 27, further comprising means for collecting, isolating
15 and separating the products deriving from oxido-destruction treatment.

29. The system according to claim 26, wherein the turbo-electrophotolytic reactor comprises the combination into one reactor body of:

- 20
- an electrolytic cell;
 - a photolytic reactor.

30. The system according to claim 29, wherein the turbo-electrophotolytic reactor comprises a cylindrical body into which the following elements are in-
25 serted:

-10-

- on one side the UV lamps, housed in a transparent Teflon cylinder;
 - on the other side the electrodes, wound as a spiral around said Teflon cylinder.
- 5 31. The system according to claim 30, in which the fluid to be subjected to the combined electrochemical-photolytic treatment flows between the negative and positive electrode while it is bombed at the same time by UV rays emitted by the lamps.
- 10 32. Use of the process according to any of the claims 1 to 16 for recycling every type of waste.
33. Use of the system according to any of the claims 17 to 31 for recycling every type of waste.
- 15 34. Use according to anyone of claims 32 and 33, for producing:
- a perfectly sterile fertilizing compost, having a liquid or fluid-dense consistency;
 - a biologically stable sterile solid dry biomass; or
 - 20 - a sterile expanded polymer, with elastic skeleton, heterogeneous flexibility and intercommunicating cells.